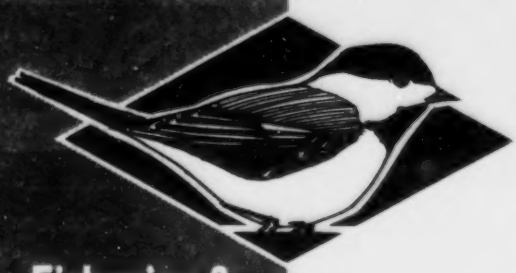

Fisheries & Wildlife Management Division

RESOURCE STATUS AND ASSESSMENT BRANCH

Status of the Red-tailed Chipmunk (Tamias ruficaudus) in Alberta

Ron Bennett

Alberta Wildlife Status Report No. 19

Alberta Conservation Association

Alberta

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PREFACE

Every five years, the Fisheries and Wildlife Management Division of Alberta Natural Resources Service reviews the status of wildlife species in Alberta. These overviews, which have been conducted in 1991 and 1996, assign individual species to 'colour' lists that reflect the perceived level of risk to populations that occur in the province. Such designations are determined from extensive consultations with professional and amateur biologists, and from a variety of readily available sources of population data. A primary objective of these reviews is to identify species that may be considered for more detailed status determinations.

The Alberta Wildlife Status Report Series is an extension of the 1996 *Status of Alberta Wildlife* review process, and provides comprehensive current summaries of the biological status of selected wildlife species in Alberta. Priority is given to species that are potentially at risk in the province (Red or Blue listed), that are of uncertain status (Status Undetermined), or which are considered to be at risk at a national level by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Reports in this series are published and distributed by the Alberta Conservation Association and the Fisheries and Wildlife Management Division of Alberta Environmental Protection, and are intended to provide detailed and up-to-date information which will be useful to resource professionals for managing populations of species and their habitats in the province. The reports are also designed to provide current information which will assist the Alberta Endangered Species Conservation Committee to identify species that may be formally designated as endangered or threatened under the Alberta Wildlife Act. To achieve these goals, the reports have been authored and/or reviewed by individuals with unique local expertise in the biology and management of each species.

EXECUTIVE SUMMARY

Red-tailed Chipmunks (Tamias ruficaudus) are small rodents that, in Alberta, occur in montane and subalpine regions of Waterton Lakes National Park and the West Castle Valley. The Red-tailed Chipmunk is currently on the 'Blue List' of species that may be at risk in Alberta based on its localized distribution and perceived threats to its habitat. There are two recognized subspecies of Red-tailed Chipmunks and southwestern Alberta is the northern range limit of one of these subspecies, T. r. ruficaudus. Populations of both subspecies are probably secure on a continental basis, but they may be vulnerable to declines in the northern portions of their ranges.

Red-tailed Chipmunks occupy mature conifer forests that have well-developed shrub understories, and appear to prefer forest openings and edges. The total area of this specific habitat type is relatively small and is likely the most important constraint determining the size and persistence of the species' population in Alberta.

The Red-tailed Chipmunk is probably not threatened with imminent extirpation in Alberta, but current population sizes and trends are poorly known. Concern for the future of the species centers on loss of habitat outside protected areas and habitat alteration resulting from long-term fire suppression or, in the future, controlled burning. Research initiatives for Red-tailed Chipmunks in Alberta should include intensive surveys to determine population size and trend as a first step in developing management guidelines.

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INTRODUCTION

Red-tailed Chipmunks (Tamias ruficaudus) are common in Idaho and Montana, but numbers in Washington and British Columbia are low. In Alberta, populations also appear to be small and recent population trends are largely unknown. Two subspecies of Red-tailed Chipmunk are currently recognized, T. r. ruficaudus and T. r. simulans but only T. r. ruficaudus has been found in Alberta (Hall 1981).

Small populations combined with a highly localized distribution has led to the inclusion of Red-tailed Chipmunks on the 'Blue List[1]' of species that may be at risk of declining to non-viable population levels in Alberta (Alberta Fish and Wildlife 1991, Alberta Wildlife Management Division 1996). Little research has been conducted on Red-tailed Chipmunks in Alberta, but this population is believed to be vulnerable to habitat loss due to its restricted distribution.

This report is an overview of historical and recent information on Red-tailed Chipmunks as a step in updating the species' status in Alberta.

HABITAT

Red-tailed Chipmunks occupy relatively moist mixed wood and conifer stands at elevations of 1200 to 1800 m (Howell 1929, Nielsen 1973, Soper 1973, Wallis and Wershler 1997). In Waterton Lakes National Park (WLNP), these elevations correspond to the Lower and Upper Subalpine Ecoregions with Red-tailed Chipmunks appearing to be most abundant in the Upper Subalpine (Wallis and Wershler 1997). Their range frequently overlaps with that of Yellow-pine Chipmunks (T. amoenus) and Least Chipmunks (T. minimus), but these species are usually found in drier open habitats than are Red-tailed Chipmunks (Best 1993, Wallis and Wershler 1997). Furthermore, Red-tailed Chipmunks are more arboreal in nature (Orr 1943, C. Wershler, pers. comm.) and have more specific habitat preferences (see 'Conservation Biology' section, below) than the other two species (Banfield 1974, Best 1993). The two subspecies of Red-tailed Chipmunks also differ in their habitat preferences with T. r. ruficaudus occurring in wetter forests at higher elevations than T. r. simulans (Banfield 1974).

During surveys conducted in WLNP in 1995-96, Red-tailed Chipmunks were recorded in the following forest types: closed to open spruce-fir and fir, stunted fir-larch, open stunted fir, open fir-larch-whitebark pine, and occasionally in open lodgepole pine (Wallis and Wershler 1997). Forest understories ranged from mixed low and tall herbs with little shrubbery to dense tall shrubbery (Wallis and Wershler 1997). Red-tailed Chipmunks were most abundant in semi-open forests, particularly those with beargrass (Xerophyllum tenax) in the understory (Wallis and Wershler 1997). These habitat types are similar to the mixed wood forests, spruce-fir associations and krummholz[2] habitats in which Red-tailed Chipmunks were found in earlier WLNP surveys (Nielsen 1973, Soper 1973, Banfield 1974).

Conifers are particularly important to Red-

[1] See Appendix 1 for definitions of selected status designations

[2] Habitat typified by stunted misshapen trees. It is usually a transition zone between the montane forest and alpine meadows.

tailed Chipmunks because they are a major source of seeds for food (Johnson 1963, Beg 1969), and large (12 to 24 m) standing trees (living and dead) are often used for nest sites (Orr 1943, Broadbooks 1974). Red-tailed Chipmunks are most abundant where the forest understory is well-developed (Orr 1943, Johnson 1963, Hoffmann and Pattie 1968) because vegetation, fruit, and seeds of shrubs and herbs are also important food sources (Best 1993). In surveys of ponderosa pine, Douglas fir, ponderosa pine-Douglas fir, and lodgepole pine stands, Johnson (1963) only found Red-tailed Chipmunks in lodgepole pine stands and attributed this to a more diverse understory that provided food during years of conifer seed crop failure.

Most of the Alberta range of Red-tailed Chipmunks is within the boundaries of WLNP so large losses of habitat have not occurred. However, some habitat in the West Castle area, which is adjacent to the north boundary of the park, has been lost to development (Gerrard and Sheppard 1993, R. Powell, pers. comm.). Habitat disturbance due to logging does not appear to have long-term effects on Red-tailed Chipmunk populations (Panian 1996, M. Fraker, pers. comm., C. Wershler, pers. comm.). Clearcutting may initially reduce chipmunk populations, but these populations usually recover to numbers at or above pre-harvest levels possibly due to increases in forest edge, and shrub and herb biomass (Halvorson 1982). In clearcuts that were burned after harvesting, Halvorson (1982) found that Red-tailed Chipmunk populations recovered more rapidly when fire intensity was low because this retained more slash piles and encouraged rapid re-growth of herbs and shrubs. Controlled burns are expected to increase in WLNP (K. Van Tighem, pers. comm.) and their effect on Red-tailed Chipmunk populations and habitat will probably also be dependent, at least partially, on fire intensity.

CONSERVATION BIOLOGY

Red-tailed Chipmunks are members of the Family Sciuridae that includes tree and ground squirrels as well as chipmunks. Formerly, chipmunk species in western North America were placed in the genus Eutamias, separate from the genus of eastern chipmunks (Tamias). Currently, all western species are included in the genus Tamias, (Levenson et al. 1985, Nadler et al. 1985), which contains approximately 22 species (Jones et al. 1992).

Red-tailed Chipmunks are one of the larger species in the genus Tamias. Their pelage ranges from light to dark grey on the back, belly, and rump; the shoulders and sides are reddish in colour, and the underside of the tail is bright orange or rust. They have alternating dark (black to fuscous) and light (tawny to greyish or creamy white) longitudinal stripes on the head and sides (Howell 1929). The body and tail colour of T. r. ruficaudus is generally darker than that of T. r. simulans, but accurate visual identification is difficult. Other morphological differences, particularly of the bacula (slender bone reinforcing the penis), allow for accurate identification between the subspecies (Patterson and Heaney 1987).

Red-tailed Chipmunks frequently occur in contiguous allopatry with two other chipmunk species (Best 1993). Least Chipmunks occupy open habitats at higher elevations than Red-tailed Chipmunks, and Yellow-pine Chipmunks occur in forested areas at lower elevations (Soper 1964). Compared to Least Chipmunks, Red-tailed Chipmunks are larger with a tail that is dark orange or red rather the light orange (Smith 1993). Red-tailed

Chipmunks are more easily confused with Yellow-pine Chipmunks, but the underside of the tail is redder and the belly is whiter in Red-tailed Chipmunks (Smith 1993). The species also exhibit behavioural differences (e.g., aggressiveness, tail flicking patterns) and appear to have distinctive calls (Banfield 1974, Panian 1996). However, definitive identification of individuals of Yellow-pine and Red-tailed Chipmunks frequently requires morphological measurements. Red-tailed Chipmunks have a larger skull with a longer rostrum (snout) than Yellow-pine Chipmunks (Howell 1929), and both the baculum and baubellum (portion of female anatomy) are larger in Red-tailed Chipmunks (Panian 1996).

Panian (1996) suggests that the more aggressive nature of Yellow-pine Chipmunks may allow them to displace Red-tailed Chipmunks from the mid-elevation habitats preferred by that species. However, Yellow-pine Chipmunks only occur at mid-elevations either when Red-tailed Chipmunks are absent, or in open dry areas that Red-tailed Chipmunks do not generally occupy (Best 1993, C. Wershler, pers. comm.). When Least Chipmunks are absent, Red-tailed Chipmunks may occupy alpine habitats (Reichel 1986), but this is probably not a preferred habitat as Red-tailed Chipmunks are physiologically less suited to these higher elevations (Heller 1971). Although the ranges and, at least partially, the habitats of these three species overlap, competitive exclusion by the other two species does not appear to affect the distribution of Red-tailed Chipmunks.

Sex ratios, age structures, and sizes of Red-tailed Chipmunk populations in Montana showed marked seasonal patterns (Beg 1971b). Breeding age males were the first chipmunks to become active after spring snowmelt. Therefore, early season samples had a male-biased sex ratio (Beg 1971b). April and May censuses showed a sex ratio of four males for each female, whereas later in the season the sexes were present in nearly equal numbers (Beg 1971b). Population sizes were lowest after emergence in spring and peaked in August (Beg 1971b). Age structure changed seasonally from spring populations dominated by adults to populations composed almost entirely of juveniles by October (Beg 1971b). Population densities in lodgepole pine stands in Montana ranged from 4.2 to 7.0 animals per hectare (Johnson 1963).

The breeding season for Red-tailed Chipmunks usually occurs in early spring with mean breeding dates increasing with elevation. In Montana, date of conception ranged from 28 April to 13 May at low elevations and from 6 to 24 May at higher elevations (Beg 1971a). However, Crowe (1943) collected a pregnant female in southern Canada on 19 August. In Montana, some females reproduced as yearlings, but pregnancy rates were higher (11 to 15% versus 68 to 83%) and litter sizes were larger for older females (Beg 1971b). For females that weaned litters each year, annual production of juveniles ranged from 3.1 to 3.2 at low elevations and from 2.4 to 3.5 at higher elevations (Beg 1971a). Although some chipmunks may survive up to eight years in the wild, generally less than 10% live past 64 months (Beg and Hoffmann 1977).

Females use burrows as nurseries for the majority of lactation, but frequently move their litters to tree nests before weaning. For their tree nests, females use tall (>12 m) conifers and build nests near the trunk in areas with dense growth of small branches and large amounts of dead twigs (Broadbooks 1974). In areas with few large trees, such as the transition

zone along alpine meadows or in burned areas, chipmunks have been observed using crevices in large boulders and piles of old logs as nest sites (Rust 1946).

In winter, Red-tailed Chipmunks spend the majority of their time in solitary burrows where they alternate between bouts of activity and torpor. During active periods, they eat seeds cached in the burrow during the previous summer (Beg 1969, Broadbooks 1974). Large conifers (Picea, Pinus and Abies spp.) are important seed sources, but Red-tailed Chipmunks also use seeds from shrubs such as Saskatoon (Amelanchier alnifolia), wild rose (Rosa spp.), and snowbrush (Ceanothus sanguineus), which may be particularly important when conifer seed production is low (Johnson 1963, Beg 1969). During the plant-growing season, chipmunks will eat the leaves, flowers, and fruits of these plants as well as many other shrubs, forbs and grasses whereas autumn foraging may be restricted almost exclusively to conifers (Beg 1969).

Little information is available regarding the influence of predation on Red-tailed Chipmunk populations or life history. The practice of transferring juveniles from burrows to tree nests before weaning may be a strategy to reduce losses to terrestrial predators during the juveniles' early explorations from the nest (Broadbooks 1974). Specific accounts of predation are lacking, but small mammal predators occurring in the mountains of southwestern Alberta include weasels (Mustela spp.), Martens (Martes americana), Coyotes (Canis latrans), Red Foxes (Vulpes vulpes), and Bobcats (Lynx rufus; Soper 1973, Smith 1993). Woodland hawks (Accipiter spp.) and large corvids (Family Corvidae) are potential avian predators (Sharp 1973, Salt and Salt 1976).

DISTRIBUTION

1. Alberta. - The range of the Red-tailed Chipmunk (T. r. ruficaudus) in Alberta is limited to the extreme southwestern corner of the province (Banfield 1974, Hall 1981, Figure 1). There is no evidence that the current provincial range is different from the historical range. The majority of historical and observational records are from WLNP (Soper 1964, Banfield 1974, Wallis and Wershler 1997), but some chipmunks have also been collected in the West Castle Valley, which is adjacent to the north boundary of the park (Smith 1993). While this is the generally recognized Alberta range for Red-tailed Chipmunks, two records exist for specimens originally identified as T. ruficaudus that were collected outside this range. One specimen (skin only) identified as T. ruficaudus was collected in the Kananaskis region, but the original identification of this specimen is questionable with body measurements more typical of T. amoenus than T. ruficaudus (W. Fitch, pers. comm., Appendix 2). Without skull measurements, which is the most accurate method for distinguishing between these two species (Howell 1929), this record should be treated with caution when defining species distribution. Furthermore, wildlife surveys in the Kananaskis region from 1976 to 1978 produced no records of Red-tailed Chipmunks (Salt and Clarke 1979). The other extralimital record cited is from Anderson and Rand (1943) and refers to a specimen collected in 1938 at the mouth of Portal Creek in Jasper National Park. Re-examination of this specimen by staff at the Canadian Museum of Nature has led to its re-designation as an example of T. amoenus ludibundus (M. Gosselin, pers. comm.).

2. Other Areas. - Outside Alberta, T. ruficaudus has been recorded in northeastern Washington,

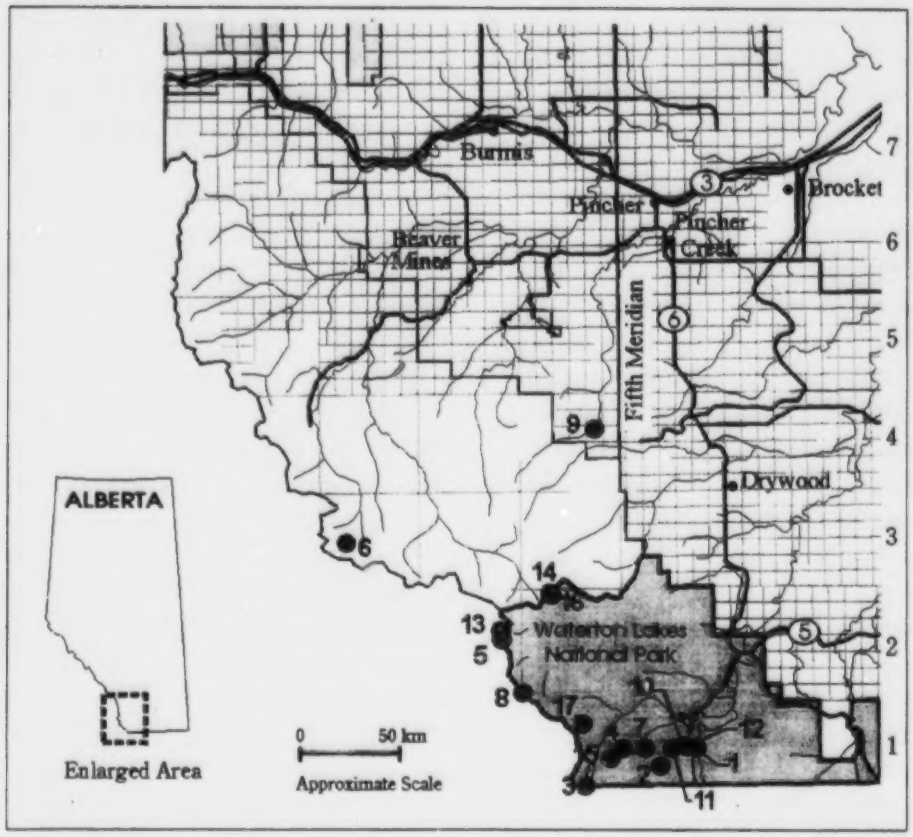

Figure 1. Known site records for Red-tailed Chipmunks in Alberta since 1895. Detailed descriptions of observations are given in Appendix 2.

northern Idaho, western Montana, and southeastern British Columbia (Hoffmann et al. 1969, Hall 1981, Patterson and Heaney 1987, Johnson and Cassidy 1997, Figure 2). The overall range is split roughly in half on a north-south axis with T. r. simulans in the western half and T. r. ruficaudus in the east (Hall 1981, Patterson and Heaney 1987, Best 1993). Only T. r. simulans is found in Washington. In Idaho, the majority of the species range is occupied by T. r. simulans, with T. r. ruficaudus limited to the southern part of the state's range. The range of T. r. simulans also extends into western Montana, but T. r. ruficaudus occupies the majority of the species' range in that state. Both subspecies occur in British Columbia, but the distribution of T. r. ruficaudus appears to be very restricted with observations limited to Akamina Pass and Sage Pass, which are adjacent to WLNP (Cowan and Guiget 1978, M. Fraker, pers. comm.). Again, no evidence exists to support a change in the distribution of the Red-tailed Chipmunk outside of Alberta.

POPULATION SIZE AND TRENDS

1. Alberta. - Only two records, both from the 1970s, exist for Red-tailed Chipmunks in the West Castle area. Trapline records and wildlife

Figure 2. Range of the Red-tailed Chipmunk in North America (modified from Patterson and Heaney 1987 and Best 1993.)

surveys in this region in the early 1990s provided no records for this species (Vacation Alberta Corporation 1992). Most records for Red-tailed Chipmunks come from WLNP, but no detailed population surveys have been conducted in the park. In field notes written between 1960 and 1965, Soper (1973) describes Red-tailed Chipmunks as "scarce to common, or fairly numerous, from one mountain locality to another" and suggests the population is similar in size to that of Least Chipmunks and substantially lower than the population of Yellow-pine Chipmunks. During the summer of 1972, Nielsen (1973) trapped chipmunks in areas not included in Soper's (1973) surveys, and rated both Least and Red-tailed Chipmunks as "uncommon". In general surveys conducted as part of the 1995-96 ecological land classification of WLNP, Red-tailed Chipmunks were rated as "uncommon", but more numerous than Least Chipmunks (Wallis and Wershler 1997). While a comparison of these ratings suggests no substantial decline in this population, the subjective nature of the ratings does not allow for reliable interpretations of either population size or trend. General surveys may also tend to underestimate population size given this species' small size and arboreal nature (Banfield 1974). A further concern with

general surveys is the potential for local synchrony of daily activity where, depending on the time of day when surveys are carried out, either most or no resident chipmunks may be encountered (M. Fraker, pers. comm.).

2. Other Areas. - No jurisdiction outside Alberta has detailed information about sizes or trends of Red-tailed Chipmunk populations. In both Idaho (C. Harris, pers. comm.) and Montana (D. Flath, pers. comm.), occurrence of Red-tailed Chipmunks is rated as frequent to common and no concerns exist about trends for these populations. No distinction has been made between the two subspecies in these assessments. The size and trend of populations (T. r. simulans only) in Washington are unknown with relatively few historical records for Red-tailed Chipmunks (Johnson and Cassidy 1997). Population sizes and trends are also lacking for British Columbia, but the population of T. r. ruficaudus is probably much smaller than that of T. r. simulans, given the former's highly restricted historical distribution (Cowan and Guiget 1978, British Columbia Conservation Data Centre 1998). Ongoing research suggests that populations of T. r. simulans in British Columbia are larger than previously suspected, but only one observation of T. r. ruficaudus has been recorded in recent (1996-97) surveys (M. Fraker, pers. comm.).

LIMITING FACTORS

1. Habitat Availability. - Standing trees may be a limiting factor for chipmunks in transitional habitats; Orr (1943) reported six chipmunks, each with separate holes, using a single dead tree located in regenerating brushland created by a forest fire. Red-tailed Chipmunks appear to have relatively specific habitat requirements, namely mature forests in the montane and sub-alpine regions (Banfield 1974, Best 1993), and this is probably the most important factor determining population size and trend. Significant changes in quality or availability of this habitat could have important consequences for this species. The total amount of habitat available is probably relatively stable in Alberta because most of the range of Red-tailed Chipmunks lies within WLNP (Smith 1993). Some habitat loss may be occurring in the West Castle area (Gerrard and Sheppard 1993, R. Powell, pers. comm.). However, the importance of habitat loss in the West Castle area is likely minimal as the paucity of records suggests this population has historically been small, and the region represents a very small portion of the total range.

2. Barriers to Movement. - The connectivity of existing habitats could be a limiting factor for Red-tailed Chipmunks because of their relatively specific habitat requirements and the occurrence of barriers (e.g., non-forested areas, rivers) to movement between pockets of habitat. Connectivity to the core of the range for T. r. ruficaudus should not be a problem for the WLNP population because this protected area adjoins Glacier National Park in Montana. However, connectivity to populations in the West Castle region and in British Columbia could be threatened because the intervening habitat is not protected. Lack of connectivity could leave isolated populations vulnerable to catastrophic events or problems associated with genetic isolation (Sullivan 1996).

3. Habitat Quality. - The most important habitat concern is the potential for long-term changes in habitat quality. Montane areas are predicted to be highly sensitive to global climate change (McDonald and Brown 1992). Therefore, existing areas of habitat could

decrease in quality or disappear as a result of global warming.

A more immediate concern relates to long-term fire suppression in WLNP that might affect habitat quality by altering natural disturbance regimes. Forests with low levels of disturbance may have less diverse understories, and fewer forest openings and edges (Attiwill 1994), both of which are important habitat features for Red-tailed Chipmunks (Orr 1943, Johnson 1963, Hoffmann and Pattie 1968, Cowan and Guiget 1978). Recent surveys of T. r. simulans in British Columbia suggest that population densities are higher in recently disturbed (burned or logged) sites (M. Fraker, pers. comm.). However, some old growth forests may have sufficient natural openings to support Red-tailed Chipmunks. The species is frequently observed in WLNP near Cameron Lake in an area of Lower Subalpine forest that includes some of the oldest trees in WLNP, and where natural disturbances have created the semi-open environment favoured by Red-tailed Chipmunks (C. Wershler, pers. comm.). That finding suggests that fire suppression does not necessarily reduce habitat quality for Red-tailed Chipmunks, but it is unclear how much disturbance is required to create sufficient forest openings, and which types and ages of forest have adequate levels of natural disturbance.

STATUS DESIGNATIONS

1. Alberta. - In both 1991 and 1996, Red-tailed Chipmunks were included on the 'Blue List' of species that may be at risk in the province (Alberta Fish and Wildlife 1991, Alberta Wildlife Management Division 1996). This classification was given because populations are assumed to be low, highly restricted in distribution, and vulnerable to habitat loss (Alberta Fish and Wildlife 1991, Alberta Wildlife Management Division 1996). Red-tailed Chipmunks are classified as 'non-game' animals under the Alberta Wildlife Act, which means it is illegal to capture or kill Red-tailed Chipmunks without appropriate permits.

2. Other Areas. - No federal listing currently exists for the Red-tailed Chipmunk in Canada (COSEWIC 1998). The Nature Conservancy ranks Red-tailed Chipmunks as G5 or 'demonstrably secure' (The Nature Conservancy 1997). In British Columbia, both subspecies are protected from hunting, both have a rank of S2 ('imperiled'), and both are on the 'Red List' of species that are threatened or endangered in the province (British Columbia Conservation Data Centre 1998). A rank of S2 has also been given to Red-tailed Chipmunks in Washington (Washington Natural Heritage Program 1998) where they are protected from hunting by state legislation and are on the state's list of species that are to be "monitored" (T. Owens, pers. comm.). In Idaho, Red-tailed Chipmunks have a rank of S4 ('apparently secure') and are classified as a 'protected non-game' species, but are not considered rare or vulnerable (C. Harris, pers. comm.). The distribution and abundance of the Red-tailed Chipmunk in Montana is such that it has no special status, has not been given an S-rank, and is not considered a priority for conservation or management activities (D. Flath, pers. comm.).

RECENT MANAGEMENT IN ALBERTA

Current plans for WLNP include monitoring Red-tailed Chipmunks every five years, although there are no plans for intensive study of this species (K. Van Tighem, pers. comm.).

No other management or research activities focusing on Red-tailed Chipmunks have occurred, or are planned, in Alberta.

SYNTHESIS

Red-tailed Chipmunks occur in Alberta at the northeastern limit of their range. This species is not threatened on a continental basis, but the Alberta population is small and has a highly restricted distribution. Most of the Red-tailed Chipmunk's Alberta range is protected. The provincial population is connected to core areas of the species' range in other protected areas, and recent surveys in WLNP suggest that this population is not in decline. So little is known about sizes and trends of Red-tailed Chipmunk populations in Alberta that conclusions about their persistence should be treated cautiously. Nevertheless, it is unlikely that the Red-tailed Chipmunk is in immediate danger of extirpation in the province.

Although only T. r. ruficaudus occurs in Alberta, management is currently focused at the species rather than the subspecies level. Differences in bacular size and shape are sufficient to suggest reproductive isolation of the two subspecies of Red-tailed Chipmunk, which implies that they are separate species (Patterson and Heaney 1987). Considering Patterson and Heaney's (1987) finding, it would be prudent to develop research and management plans for both subspecies rather than a single species plan.

Initial research should focus on intensive surveys to determine the current size and trend of Alberta populations, which is necessary for developing management guidelines. These surveys would be aided by studies on pelage characteristics and vocalizations that would simplify field identification (C. Wershler, pers. comm.). Seasonal variations in the size, sex ratio, and age structure of populations should be considered when planning surveys because of their potential to bias the resulting data. Subsequent research should be aimed at assessing important features of the ecology of Red-tailed Chipmunks in Alberta such as reproductive output, survivorship, and habitat use. Controlled burning in WLNP is expected to increase in the future. It will therefore also be important to encourage research into the effects of fire on chipmunk habitat and populations.

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APPENDIX 1. Definitions of selected legal and protective designations.

A. Status of Alberta Wildlife colour lists (after Alberta Wildlife Management Division 1996)

Red	Current knowledge suggests that these species are at risk. These species have declined, or are in immediate danger of declining, to nonviable population size
Blue	Current knowledge suggests that these species may be at risk. These species have undergone non-cyclical declines in population or habitat, or reductions in provincial distribution
Yellow	Species that are not currently at risk, but may require special management to address concerns related to naturally low populations, limited provincial distributions, or demographic/life history features that make them vulnerable to human-related changes in the environment
Green	Species not considered to be at risk. Populations are stable and key habitats are generally secure
Undetermined	Species not known to be at risk, but insufficient information is available to determine status

B. Alberta Wildlife Act

Species designated as 'endangered' under the Alberta Wildlife Act include those defined as 'endangered' or 'threatened' by *A Policy for the Management of Threatened Wildlife in Alberta* (Alberta Fish and Wildlife 1985):

Endangered	A species whose present existence in Alberta is in danger of extinction within the next decade
Threatened	A species that is likely to become endangered if the factors causing its vulnerability are not reversed

C. Committee on the Status of Endangered Wildlife in Canada (after COSEWIC 1998)

Extirpated	A species no longer existing in the wild in Canada, but occurring elsewhere
Endangered	A species facing imminent extirpation or extinction
Threatened	A species likely to become endangered if limiting factors are not reversed
Vulnerable	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events
Not at Risk	A species that has been evaluated and found not to be at risk
Indeterminate	A species for which there is insufficient scientific information to support status designation

D. United States Endangered Species Act (after National Research Council 1995)

Endangered	Any species which is in danger of extinction throughout all or a significant portion of its range
Threatened	Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range

E. Natural Heritage Element Rarity Ranks (after The Nature Conservancy 1998)

Global or G-rank: Based on the range-wide status of a species.
Sub-national or S-rank: Based on the status of a species in an individual state or province. S-ranks may differ between states or provinces based on the relative abundance of a species in each state or province.

G1 / S1	Critically imperiled because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction
G2 / S2	Imperiled because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range
G3 / S3	Either very rare or local throughout its range, or found locally in a restrcited range (21 to 100 occurrences)
G4 / S4	Apparently secure, though it might be quite rare in parts of its range, especially at the periphery
G5 / S5	Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery

APPENDIX 2. Red-tailed chipmunk specimens and observations from Alberta, 1895-1996.

Site No. [1]	Year	Number of Individuals	Location	Description [2]	Source [3]
1	1895	1	49°02'N; 113°54'W	WLNP	CMN
2	1922	1	49°01'N; 113°57'W	WLNP, near Bertha Lake	CMN
	1922	1		WLNP, Sheep Mountain	CMN
3	1922	1	49°00'N; 114°03'W	WLNP, Cameron Lake	CMN
3	1922	1	49°00'N; 114°03'W	WLNP, Cameron Lake	CMN
	1922	1		WLNP	CMN
4	1922	1	49°02'N; 114°00'W	WLNP, Mt. Carthew Trail	CMN
	1922	1		WLNP, Summit Lake	CMN
3	1922	1	49°00'N; 114°03'W	WLNP, Cameron Lake	CMN
3	1922	1	49°00'N; 114°03'W	WLNP, Cameron Lake	CMN
3	1938	1	49°00'N; 114°03'W	WLNP, Cameron Lake	UAMZ
	1939	1		WLNP	UAMZ
	1939	1		WLNP	UAMZ
5	1945	1	49°08'N; 114°10'W	WLNP, Akamina Pass	CMN
5	1945	1	49°08'N; 114°10'W	WLNP, Akamina Pass	CMN
5	1945	1	49°08'N; 114°10'W	WLNP, Akamina Pass	CMN
5	1945	1	49°08'N; 114°10'W	WLNP, Akamina Pass	CMN
5	1945	1	49°08'N; 114°10'W	WLNP, Akamina Pass	CMN
5	1945	1	49°08'N; 114°10'W	WLNP, Akamina Pass	CMN
3	1960	1	49°00'N; 114°03'W	WLNP, Cameron Lake	UAMZ
5	1960	1	49°08'N; 114°10'W	WLNP, Twin Lakes	UAMZ
6	1972	1	49°13'N; 114°22'W	Headwaters of the West Castle River	UAMZ
7	1972	1	49°02'N; 113°58'W	WLNP, Alderson Lake	WLNP
7	1972	1	49°02'N; 113°58'W	WLNP, Alderson Lake	WLNP
7	1972	1	49°02'N; 113°58'W	WLNP, Alderson Lake	WLNP
8	1972	1	49°05'N; 114°08'W	WLNP, Lone Lake	WLNP
9	1973	1	49°19'N; 114°02'W	18 miles S 6 miles W of Pincher Creek	UAMZ
	Unknown	1		Kananaskis	UCMZ
10	1996	1	49°02'05"N; 113°55'08"W	WLNP, Bertha Creek drainage	WLNP
11	1996	3	49°01'57"N; 113°55'57"W	WLNP, Bertha Creek drainage	WLNP
12	1996	1	49°02'03"N; 113°54'46"W	WLNP, Bertha Creek drainage	WLNP
13	1996	1	49°08'17"N; 114°09'39"W	WLNP, Bauerman Creek drainage	WLNP
14	1996	1	49°10'15"N; 114°05'42"W	WLNP, Bauerman Creek drainage	WLNP
15	1996	2	49°01'25"N; 114°00'57"W	WLNP, Boundary Creek drainage	WLNP
16	1996	1	49°10'08"N; 114°05'46"W	WLNP, Rowe Creek drainage	WLNP
17	1996	2	49°03'17"N; 114°03'11"W	WLNP, Bauerman Creek drainage	WLNP

[1] Numbered sites are located on Figure 1

[2] WLNP = Waterton Lakes National Park

[3] CMN= Canadian Museum of Nature; UAMZ= University of Alberta Museum of Zoology; UCMZ= University of Calgary Museum of Zoology; WLNP= Waterton Lakes National Park

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